CHAPTER 2

Criteria Pollutants — National Trends

http://www.epa.gov/oar/airtrends

This chapter presents national and regional trends for each of the six criteria pollutants for which the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS): carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). Table 2-1 lists the NAAQS for each pollutant in terms of the level and averaging time of the standard used to evaluate compliance.

There are two types of standards: primary and secondary. Primary standards protect against adverse human health effects, whereas secondary standards protect against welfare effects such as damage to crops, ecosystems, vegetation, and buildings, as well as decreased visibility. There are primary standards for all of the criteria pollutants. Some pollutants (PM and SO_2) have primary standards for both long-term (annual average) and short-term (24 hours or less) averaging times. Short-term standards most directly protect people from adverse health effects associated with peak short-term exposures to air pollution, whereas long-term standards can protect people from adverse health effects associated with short- and long-term exposures to air pollution.

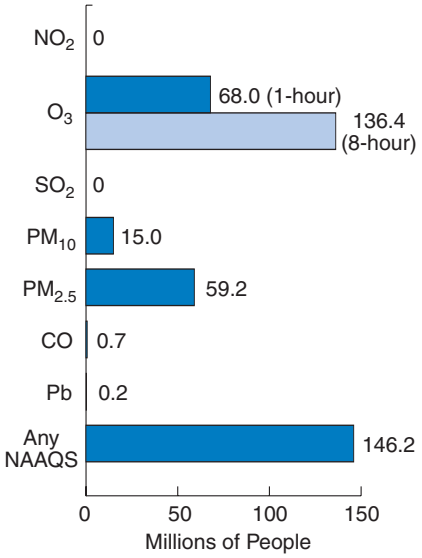
Table 2-1. NAAQS in Effect as of December 2002

	Primary Standard (Health-Related)		Secondary Standard (Welfare-Related)	
Pollutant	**Type of Average**	**Standard Level Concentration[a]**	**Type of Average**	**Standard Level Concentration[a]**
CO	8-hour[b]	9 ppm (10 mg/m^3)	No Secondary Standard	
	1-hour[b]	35 ppm (40 mg/m^3)	No Secondary Standard	
Pb	Maximum Quarterly Average	1.5 µg/m^3	Same as Primary Standard	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	Same as Primary Standard	
O_3	Maximum Daily 1-hour Average[c]	0.12 ppm (235 µg/m^3)	Same as Primary Standard	
	4th Maximum Daily[d] 8-hour Average	0.08 ppm (157 µg/m^3)	Same as Primary Standard	
PM_{10}	Annual Arithmetic Mean	50 µg/m^3	Same as Primary Standard	
	24-hour[e]	150 µg/m^3	Same as Primary Standard	
$PM_{2.5}$	Annual Arithmetic Mean[f]	15 µg/m^3	Same as Primary Standard	
	24-hour[g]	65 µg/m^3	Same as Primary Standard	
SO_2	Annual Arithmetic Mean	0.03 ppm (80 µg/m^3)	3-hour[b]	0.50 ppm (1,300 µg/m^3)
	24-hour[b]	0.14 ppm (365 µg/m^3)		

[a] Parenthetical value is an approximately equivalent concentration. (See *40 CFR* Part 50.)
[b] Not to be exceeded more than once per year.
[c] The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1, as determined according to Appendix H of the Ozone NAAQS.
[d] Three-year average of the annual 4th highest daily maximum 8-hour average concentration.
[e] The short-term (24-hour) standard of 150 µg/m^3 is not to be exceeded more than once per year on average over 3 years.
[f] Spatially averaged over designated monitors.
[g] The form is the 98th percentile.

Secondary standards have been established for each criteria pollutant except CO. Secondary standards are identical to the primary standards, with the exception of the one for SO_2. As Figure 2-1 shows, approximately 146 million people in the United States reside in counties that did not meet the primary standard for at least one of the criteria pollutants for the single year 2002.

Figure 2-1. Number of people living in counties with air quality concentrations above the level of NAAQS in 2002.



The trends information presented in this chapter is based on two types of data: ambient concentrations and emissions estimates. Ambient concentrations are measurements of pollutant concentrations in the ambient air from monitoring sites across the country. This year's report contains trends data accumulated between 1983 and 2002 on the criteria pollutants at thousands of monitoring stations located throughout the United States. For some pollutants, 2002 data are provided; for other pollutants (e.g., lead), 2001 data are reported. In each case, the most recent, complete data are used, with the relevant years clearly noted. The trends presented here are derived from the composite average of these direct measurements. The averaging times and air quality statistics used in the trends calculations relate directly to the NAAQS.

The second type of data presented in this chapter are national emissions estimates. These are based largely on engineering calculations of the amounts and kinds of pollutants emitted by automobiles, factories, and other sources over a given period. In addition, some emissions estimates are based on measurements from continuous emissions monitors (CEMs) that have been installed at major electric utilities to measure actual emissions. The emissions data summarized in this chapter and in Appendix A were obtained from the National Emission Inventory data located at **http://www.epa.gov/ttn/chief**.

Methods for estimating emissions continue to evolve. For example, the emissions data presented here reflect the use of new models for estimating volatile organic compounds (VOCs), nitrogen oxides (NO_x), and CO emissions from highway vehicles and nonroad engines. Also, emissions from wildfires and prescribed burning have not been projected for 2002 for PM, CO, and VOCs, due to the high degree of uncertainty in predicting emissions for these fires. For a complete description of the methodology changes for calculating emissions, see Appendix B.

Changes in ambient concentrations do not always match changes in national emissions estimates, for several reasons. First, because most monitors are positioned in urban, population-oriented locales, air quality trends are more likely to track changes in urban emissions rather than changes in total national emissions. Urban emissions are generally dominated by mobile sources, whereas total emissions in rural areas may be dominated by large stationary sources such as power plants and smelters.

Second, emissions for some pollutants are calculated or measured in a different form than the primary air pollutant. For example, concentrations of O_3 are caused by VOC emissions as well as NO_x emissions.

Third, the amount of some pollutants measured at monitoring locations depends on what chemical reactions, if any, occur in the atmosphere during the time it takes the pollutant to travel from its source to the monitoring station.

Fourth, meteorological conditions often control the formation and buildup of pollutants in the ambient air. For example, peak ozone concentrations typically occur during hot, dry, stagnant summertime conditions. CO is predominantly a cold weather problem. Also, the amount of rainfall can affect particulate matter levels.

Fifth, emissions estimates have uncertainties and may not reflect actual emissions. In some cases, estimation methods are not consistent across all years presented in this report.

For a more detailed discussion of the methodology used to compute the trend statistics in this chapter, please refer to Appendix B.